An Analysis on Influence Factors to Use Frequency and WTP of Shopping Support Services for People in Food Desert

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Synopsis

Recently, the food desert problem has been becoming serious problem in mainly rural areas of Japan, because it must be improved by local responsibility according to local needs. Although some estimation methods of the number of people in food desert (PFD) were developed, the estimations of the demand for and profit from shopping support service will be also required. Therefore, this paper mainly aims to gain the fundamental knowledge not only to develop the estimation model of the demand for shopping support service for PFD but also to evaluate the profit of them at local level, by the factor analysis including individual attributes and area characteristics.

As a result, some important findings, concerned with influence factors to use frequency and WTP of shopping support services, came out of this study. These results must be useful information to introduce the suitable shopping support services for PFD in consideration of local needs.

KEYWORDS: People in food desert, Shopping support service, Use frequency, WTP, Factor analysis

1. Introduction

Recently, the food desert problem become serious in mainly rural areas of Japan, because of recent social changes: 1) declining in level of public transport services, 2) declining birth rate and growing proportion of elderly people, 3) increasing nuclear families and 4) decreasing the number of local commercial facilities and so on. Therefore, Ministry of Economy, Trade and Industry (METI) and Ministry of Agriculture, Forestry and Fisheries (MAFF) have been making various efforts to solve the food desert problem, such as estimation of the number of PFD based on original methods and publishing of the shopping accessibility aid manual and so on. On the other hand, Ise *et al*. (2013) and Hirai *et al*. (2012) pointed out that the estimation methods developed by METI and MAFF are impossible to estimate the number of PFD at local level, and they had conducted fundamental studies to develop the new estimation method of the number of PFD.

It can be said that the following matters are essential to decide the shopping support service for local needs: 1) the number of PFD, 2) the demand for each shopping support service, 3) the profit from introducing each of them and 4) discussion with various kind of parties such as local government, local residents, private companies and academic experts and so on. However, manuals mentioned above are not enough knowledge to do that, because they do nothing but introduce some of pioneering projects.

Kuramochi *et al*. (2014) developed the discrete choice model to estimate the number of delivery service users based on the questionnaire survey for elderly people in rural areas. Tanimoto *et al*. (2012) determined five choice patterns of shopping support services by combination of two shopping support services and relative use frequency of them transformed into ordinal scale, and developed the multinomial probit model to estimate the number of users of “transport support service” and “delivery service” considering mental and physical functions of elderly people. However, there are some issues in these researches: 1) not considering non-elderly people and 2) they cannot estimate the use frequency of shopping support services for PFD.

Kishino *et al*. (2011) clarified the relationship between use frequency of shopping support services and some valuables such as individual attributes, family structure and physical ability and so on. However, some findings from this research is not enough to estimate the demand of shopping support services because they analyzed the relationship between use frequency of shopping support services and some valuables separately.

Therefore, this paper mainly aims to gain the fundamental knowledge to develop the model for

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estimating the demand for each shopping support service for PFD and the profit from introducing each of them at local level, from the analysis of factors influencing use frequency and WTP of shopping support services for PFD considering individual attributes and area characteristics.

2. Outline of Target Town

Hidakagawa town in Wakayama, Japan is the target town in this study, which was created by the municipal merger between Kawabe town, Nakatsu village, and Miyama village in May 2005, as shown in Figure 1. This town is located at the center of Wakayama prefecture, which has an area of 331.65 km^2 (35km from east to west in width, 10km from north to south in width). Population size is very small (population is 10,509 and the number of household is 3,750). The density of population is also very small, but the ratio of elderly people is 10.4% higher than the national average (20.1%). In addition to the above, this town faces some problems such as decreasing of population and increasing of nuclear families. A railway is located in the southwest of this town, but there are only two stations. In addition to a few stations, train runs once every hour. Bus, community bus and share-ride taxi run in this town, but they run about two to eight times a day. All these things make it clear that the conditions of public transport in this town are poor. A lot of local residents pointed out that the conditions of public transport and daily shopping are poor, in the first long-term comprehensive development plan of this town.

As mentioned above, it is very urgent and important to support for grocery shopping of people in food desert in this town.

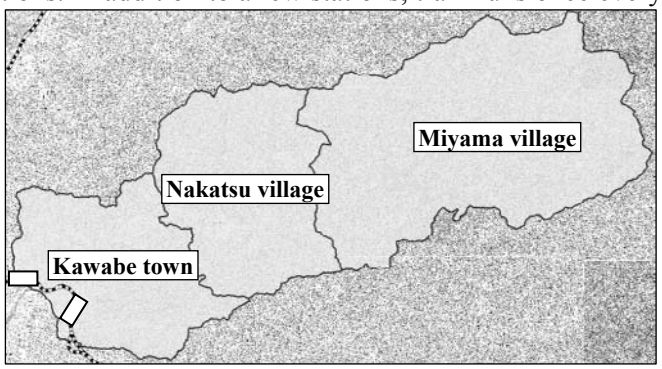

Figure 1. Hidakagawa town as the study field

3. Outline of Questionnaire Survey

The questionnaire survey was conducted from October to November 2013, in order to clarify the factors influencing use frequency and WTP of shopping support services for PFD. The main questionnaire items are individual attributes, conditions of public transport, condition of grocery shopping, difficulty with grocery shopping, user frequency and potential needs of shopping support services as shown in Table 1. The respondents are local residents except students and pupils, who were randomly sampled in Hidakagawa town. As a result, 1749 respondents were obtained from distributed 6000 questionnaire sheets.

Table 1. Main items of questionnaire survey

Items	Details
Individual attributes	・Address, ・Sex, ・Age, ・Household composition, ・Certification of care need, ・Pain-free walking time, ・Availability of car and motorbike
Conditions of public transport	・Walking time to get to the nearest station ・Walking time to get to the nearest stop of bus (including share-ride taxi)
Conditions of grocery shopping	・Type of the nearest grocery store ・Distance from home to the nearest grocery store ・Conditions of mobile grocery stores and grocery delivery ・Presence of the person who support grocery shopping
Difficulty with grocery shopping	・Difficulty with grocery shopping
Use frequency of shopping support services	・Use frequency of shopping support services such as “going out”, “mobile grocery store”, and “grocery delivery”
Needs of shopping support services	・Needs of improvement of each support for grocery shopping ・Intention to use each improved support for grocery shopping ・Willingness to pay for each improved support for grocery shopping

4. Conditions of Public Transport and Present Situation of PFD

4.1. Conditions of public transport

As for the accessibility to the nearest station, all residents in Nakatsu and Miyama villages and a half of residents in Kawabe town cannot access to the nearest station within 30 minutes on foot, as shown in Figure 2, because of the location of each residential area (See Figure 1). On the other hand, almost all of residents may be able to access to the nearest bus stop within 15 minutes on foot, as shown in Figure 3.

However, from a different angle, about 10 % more of residents must be not able to access to any public transport within 15 minutes on foot.

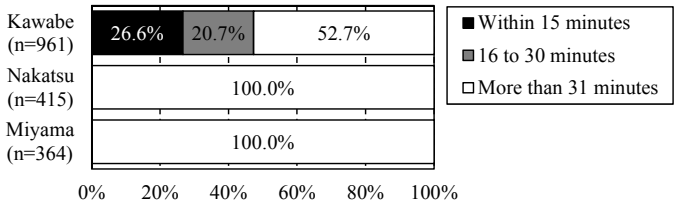

Figure 2. Walking time to get to the nearest station

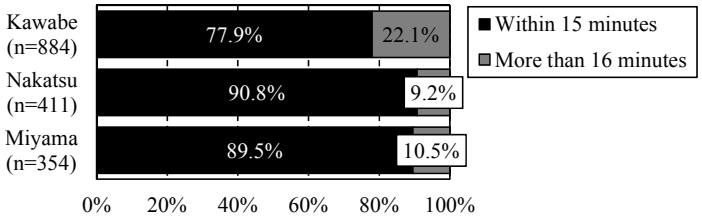

Figure 3. Walking time to get to the nearest bus stop

4.2. Ratio and age distribution of PFD

The Figure 4 shows the ratio and age distribution of PFD. PFD is respondents who answered “Usually difficult”, “Sometimes difficult” and “Seldom difficult”, to question “Do you have difficulty with grocery shopping”. As a result, it can be seen that other factors except conditions of public transport may have an influence on difficulty with grocery shopping, as the ratio of PFD of Nakatsu village is the highest in Hidakagawa town. On the other hand, it can be said that residents of under 65 years old should be taken into consideration, in order to estimate the number of PFD and consider some shopping support services for PFD.

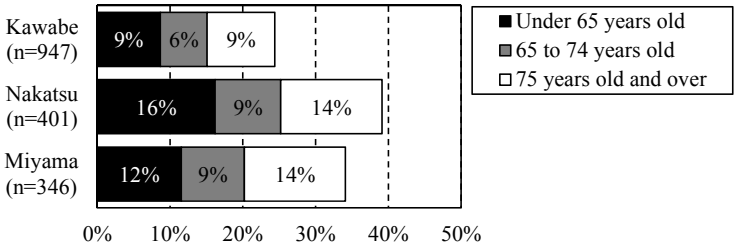

Figure 4. Ratio and age distribution of PFD

4.3. Use frequency of shopping support services of PFD

The use frequency of each shopping support service of PFD is summarized in Figure 5. In an analysis of use frequency of “transport support service”, the frequency of go out shopping by local public transport such as bus and taxi should be focused. However, the number of users of local public transport is very small. Therefore, all respondents who go out for shopping are included in this analysis, and this result is used for comparing with use frequency of other shopping support services. In analyses of use frequency of “mobile vendor” and “home delivery service”, respondents who answered “do not use” or “no service” are not included.

According to “go out shopping” of Figure 5, the ratio of those who go out shopping one to three times

a week is 65 %. It is inferred that people in rural area buy a lot of foods at one time, in order to reduce inconvenience of going out shopping.

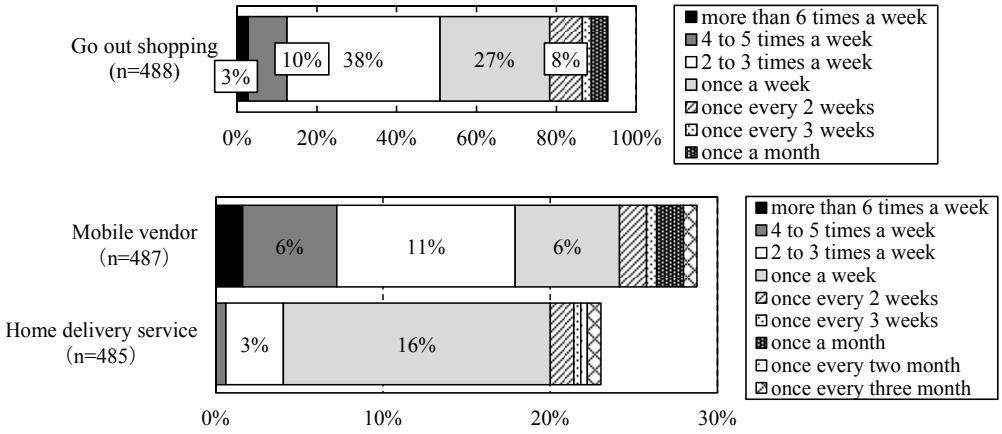

Figure 5. Use frequency of each shopping support services for PFD

4.4. Willingness to pay (WTP) for the use of shopping support services for PFD

Figure 6 shows the WTP for the use of each shopping support service for PFD. WTP in this study means one-way fare for transport support service, pay-per-use fee for mobile vendor and pay-per-use fee for home delivery service.

77% of respondents are willing to pay for transport support service, and most of WTP ranges from 100 JPY to 700 JPY. The ratio of respondents who are willing to pay for mobile vendor and home delivery service is lower than that for transport support service. It might be because users of mobile vendor and home delivery service can only do shopping and cannot buy some foods from many.

On the other hand, there are a few respondents who are willing to pay more than 1500 JPY for mobile vendor and home delivery service. It can be said that mobile vendor and home delivery service are very important for people with limited access to shopping facilities.

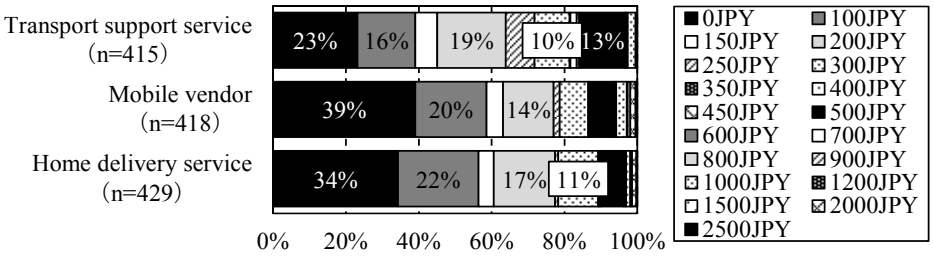

Figure 6. WTP for the use of each shopping support service for PFD

5. Analysis of Factors Influencing Use Frequency of Shopping Support services for PFD

In this chapter, factors influencing use frequency of shopping support services for PFD are clarified by using quantification theory type I.

As mentioned in section 4.3, the frequency of go out shopping by local public transport such as bus and taxi should be focused, in order to gain the fundamental knowledge to model demand for transport support service. However, the number of users of local public transport is very small. Therefore, all respondents who go out shopping are included in this analysis, and this result is used for comparing with use frequency of other shopping support services.

As shown in Figure 5, options of use frequency setting in this questionnaire survey have different unit such as “1(time/week)” and “1(time/2weeks)”. And some of them have a range such as “2~3(times/week)”. Therefore, unit of use frequency was converted to “times/day”. For example, “4~5(times/week)” is converted into “4.5/7(times/day)” and “1(time/month)” is converted into “1/28(times/day)”. In addition, “less than 1(time/month)” and “do not use” are converted into 0(times/day). In analyses of mobile vendor and home delivery service, only respondents who can use these services are included. Independent variables using for

these analyses achieve statistical significance based on one-way analysis of variance. And, all results also do not have problem of "multi-collinearity".

5.1. Go out shopping

The result of Figure 7 indicates that, those who go out shopping comparatively frequently have following characteristics: 1) under 65 years old, 2) pain-free walking time is more than 21 minutes and 3) possible to use a car (driving by oneself and others). Therefore, it can be seen that decline in physical performance with age makes people decrease the frequency of go out shopping. And, other factors influencing the frequency of go out shopping are the distance from home to central area of Hidakagawa town, the distance from home to the nearest grocery store, presence of the people who support grocery shopping and assortment of foods.

Independent variables			Categorical values
Individual attributes	Age	Under 65	
		65 to74	
		75and over	
	Pain-free walking time	Within 10 min	
		11 min to 20 min	
		More than 21 min	
	Car	Having	
		Not having	
Conditions of public transport	Walking time to get to the nearest station	Within 20 min	
		More than 21 min	
Conditions of grocery shopping	Type of the nearest grocery store (private store)	Yes	
		No	
	Distance from home to the nearest grocery store	Within 2km	
		More than 2km	
	People who support grocery shopping	Presence	
		Absence	
		multiple correlation coefficient	**-2.0 -1.0 0 1.0 2.0**
		0.29	**[times/day]**

Figure 7. Analysis on factors influencing frequency of go out shopping

5.2. Mobile vendor

Figure 8 makes it clear that factors influencing use frequency of mobile vendor are different from those of go out shopping. In other words, the use frequency of mobile vendor increases with age. In addition, people living in areas poorly served by local public transport and grocery stores, depend strongly on mobile vendor. Accordingly, mobile vendor is used frequently as a supplement or alternative to go out shopping, because of the decline in physical performance with age and poor local public transport and grocery stores.

Independent variables			Categorical values
Individual attributes	Age	Under 65	
		65 to74	
		75and over	
	Car for driving by yourself	Having	
		Not having	
Conditions of public transport	Walking time to get to the nearest station	Within 20 min	
		More than 21 min	
Conditions of grocery shopping	Type of the nearest grocery store (super market or shopping center)	Yes	
		No	
	Home delivery service	Available	
		Unavailable	
		multiple correlation coefficient	**-0.15 -1.0 -0.05 0 0.05 1.0 0.15**
		0.37	**[times/day]**

Figure 8. Analysis on factors influencing use frequency of mobile vendor

5.3. Home delivery service

Figure 9 makes it clear that factors influencing use frequency of home delivery service are similar with those of mobile vendor. That is to say, people living in areas poorly served by local public transport and grocery stores, depend strongly on home delivery service.

Independent variables			Categorical values
Individual attributes	Sex	Male	
		Female	
	Pain-free walking time	Within 10 min	
		More than 11 min	
	Car	Having	
		Not having	
Conditions of public transport	Walking time to get to the nearest station	Within 15 min	
		More than 16 min	
Conditions of grocery shopping	Mobile vendor	Available	
		Unavailable	
	People who support grocery shopping	Presence	
		Absence	
		multiple correlation coefficient	**-0.1 -0.05 0 0.05 1.0**
		0.29	**[times/day]**

Figure 9. Analysis on factors influencing use frequency of home delivery service

6. Analysis of Factors Influencing WTP for the Use of Shopping Support Services for PFD

In this chapter, factors influencing WTP for the use of shopping support services for PFD are clarified by using quantification theory type I. As with the analysis in Chapter 5, Independent variables using for these analyses achieve statistical significance based on one-way analysis of variance. And, all results also do not have problem of "multicollinearity".

6.1. Transport support service

As shown in Figure 10, those who are willing to pay comparatively high for transport support service, have following characteristics: 1) independence state, support required and need of nursing care, 2) pain-free walking time is less than 3 minutes and 3) impossible to use a car (driving by oneself). It is probable that, although people become dependent on mobile vendor and home delivery service due to decline in physical performance with age, they have potential demand for transport support service.

Factors related to accessibility of local public transport and shopping environment, do not achieve statistical significance. "Residential area" was used as explanatory variable instead of "walking time to get to

Independent variables			Categorical values
Individual attributes	Residential area	Kawabe	
		Nakatsu	
		Miyama	
	Sex	Male	
		Female	
	Certification of care need	Not requiring	
		Requiring*	
	Pain-free walking time	Within 3 min	
		More than 3 min	
	Car for driving by yourself	Having	
		Not having	
		multiple correlation coefficient	**-100 -50 0.0 50 100**
		0.29	**[JPY/one-way]**

* Requiring includes "independence state", "support required", "need of nursing care".

Figure 10. Analysis on factors influencing WTP for the use of transport support service

the nearest station", because options of "walking time to get to the nearest station" cannot express in detail the differences in distance from home to central area of Hidakagawa town. As a result, "residential area" achieved statistical significance, and transport support service is the most necessary in Miyama village where is the farthest area from central area of Hidakagawa town.

6.2. Mobile vendor

There are a few explanatory valuables which achieve statistical significance (Figure 11). However, those who are willing to pay comparatively high for mobile vendor, has following characteristics: 1) more than 60 years old, 2) pain-free walking time is less than 3 minutes and 3) walking time to get to the nearest station is more than 26 minutes. That is, individual attributes have a great influence on WTP for the use of mobile vendor, as is case in WTP for the use of transport support service.

Independent variables			Categorical values
Individual attributes	Age	Under 65	
		65 and over	
	Pain-free walking time	Within 3 min	
		More than 3 min	
Conditions of public transport	Walking time to get to the nearest station	Within 25 min	
		More than 26 min	
		multiple correlation coefficient	-200 0.0 200 400 600 [JPY/time]
		0.21	

Figure 11. Analysis on factors influencing WTP for the use of mobile vendor

6.3. Home delivery service

There is no explanatory valuable which achieves statistical significance. Therefore, it is said that, other factors which do not considered in this research, have an influence on WTP of home delivery service. As a result of calculating average WTP of each shopping support service, transport support service is 221 JPY, mobile vendor is 205 JPY and home delivery service is 185 JPY. Hence, average WTP for the use of home delivery service is the lowest in other average WTP.

From the above, although people become dependent on mobile vendor and home delivery service due to decline in physical performance with age, they have potential demand for transport support service, as it was mentioned in **6.1**.

7. Conclusion

This study mainly aimed to gain the fundamental knowledge to develop the model for estimating the demand for each shopping support service for PFD and the profit from introducing each of them at local level, from the analyses of factors influencing use frequency and WTP of shopping support services for PFD considering individual attributes and area characteristics.

As a result, all factor analysis except WTP of home delivery service clarified some factors influencing use frequency and WTP of shopping support services for PFD. Factors influencing the frequency of go out shopping by using bus and taxi, are not clarified, because the number of users of local public transport is very small. However, some findings from **5.1** were very useful to compare with other factor analysis about use frequency.

Other major findings are summarized as follows.

1) There are difficulties for people to go out shopping, because of the decline in physical performance with age and poor local public transport and shopping facilities. And, those who have difficulty to go out shopping, depend on mobile vendor and home delivery service.
2) As for the WTP for the use of transport support service and mobile vendor, elderly and disabled people are willing to pay more high than others.
3) Those who decrease in physical performance with age, depend on mobile vendor and home delivery service. However, they need an improvement of transport support service, because Average WTP for the use of transport support service is also highest.

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References

1) Ministry of Economy, Trade and Industry, *Report of research group to consider the future of logistics for supporting the infrastructure for local life* (2010).
2) Ministry of Agriculture, Forestry and Fisheries, *Present situation and future policy of food desert problem* (2012).
3) Ministry of Economy, Trade and Industry, *Second edition of* "*Shopping Accessibility Aid Manual*" (2011).
4) Ministry of Agriculture, Forestry and Fisheries, *Guidebook for considering shopping support service for people in food desert* (2014).
5) N. Ise and M. Shoji, *An Analysis on Influencing Factors on Difficulty of Shopping Accessibility by Considering Individual Attributes and Area Characteristics*, *Journal of Traffic Engineering*, Vol.33, 463-466 (2013).
6) H. Hirai, M. Minami, *Estimation of the Number of People in Food Desert targeting Elderly People in Morioka city Iwate Prefecture*, *Proceedings of Infrastructure Planning* (CD-ROM), Vol.46, 5pages (2012).
7) H. Kuramochi, K. Tanimoto and S. Tsuchiya, *Shopping Support in Rural Depopulated Areas*:*Focusing on Delivery Services*, *Journal of Sociotechnology*, Vol.11, 33-43 (2014).
8) K. Tanimoto and K. Onishi, *A Consideration on the Choice of Support Services of Daily Life according to Physical and Mental Function of Elder People*, *Proceedings of Infrastructure Planning* (CD-ROM), Vol.45, 4pages (2012)
9) K. Kishino, H. Kita, T. Ochi and H. Yotsutsuji, *A Fundamental Analysis on the Methods to Have Opportunities of Daily Activities in Rural Area*, *Journal of Traffic Engineering*, Vol.31, 393-398 (2011)